

4.1 GEOLOGY AND COASTAL PROCESSES

This section addresses the issues of geology, seismology, and physical oceanography (currents and sediment transport). The existing regional condition of these topics in the vicinity of the Proposed Project is discussed, followed by an evaluation of the potential impacts of the Proposed Project on these topics.

4.1.1 Environmental Setting

4.1.1.1 Geology

The project area is located on the northern edge of the Santa Barbara Channel in the western part of the Transverse Range Physiographic Province. This region is characterized by east-west oriented topographic and structural elements. The Santa Barbara Channel is the submerged western extension of the Ventura Basin, and is bounded on the north by the Santa Ynez Range and on the south by the northern Channel Islands. Total relief from the western portion of the Santa Ynez Mountains to the floor of the Santa Barbara Channel is about 6,000 ft. The Santa Ynez Mountains rise from a narrow coastal plain to elevations of more than 4,000 ft (1,219 m).

Offshore, the mainland shelf slopes gently seaward from the coastline to depths of about 280 ft (85 m) where it intersects the northern slope of the Santa Barbara Channel. The mainland slope dips relatively steeply toward the center of the Santa Barbara Channel. Water depths in the central part of the Channel vary from 650 to 2,000 ft (198 to 610 m). To the south, the Santa Barbara Channel rises along a submarine slope to a narrow nearshore shelf bordering the four northern Channel Islands: Anacapa, Santa Cruz, Santa Rosa, and San Miguel. These islands represent the western physiographic extension of the Santa Monica Mountains. Maximum elevations of the Channel Islands vary from 830 ft (253 m) on San Miguel Island to 2,450 ft (747 m) on Santa Cruz Island.

The Santa Barbara Channel is underlain by a thick sequence of upper Mesozoic and Tertiary marine and continental sediments resting on basement rocks of the Jurassic-age Franciscan complex. It is bounded on the north and south by major east-west trending fault systems described below.

A 1999 survey of the area found that Pier PRC-421 is located in an area with both sandy bottom and rocky outcrop areas (Figure 4.1-1). The seafloor surface, downcoast from the pier to a distance of at least 1,000 ft (305 m), the extent of the survey and offshore to 300 ft (91 m) from the structure consists of rock outcrop. Inshore from the structure, rock outcrops and reefs are more scattered to an approximate depth of ≤ 20 ft (≤ 6 m), at which point the presence of thick kelp implies the shoreward presence of more consistent rock bottom. Upcoast from the Pier, sandy bottom is interspersed with rock outcroppings.

4.1.1.2 Earthquake Faults

The Santa Ynez fault system to the north of the Santa Barbara Channel is over 90 miles long and was responsible for the uplift of the Santa Ynez Mountains in late Tertiary to Quaternary time. To the south is the Santa Monica-Santa Cruz Island fault system. Both the Santa Ynez and Santa Monica-Santa Cruz Island fault systems are characterized by left-lateral strike-slip and reverse separations along their lengths. In addition to these two major fault systems, numerous left-oblique and reverse faults and steep-limbed folds occur within and adjacent to the Santa Barbara Channel.

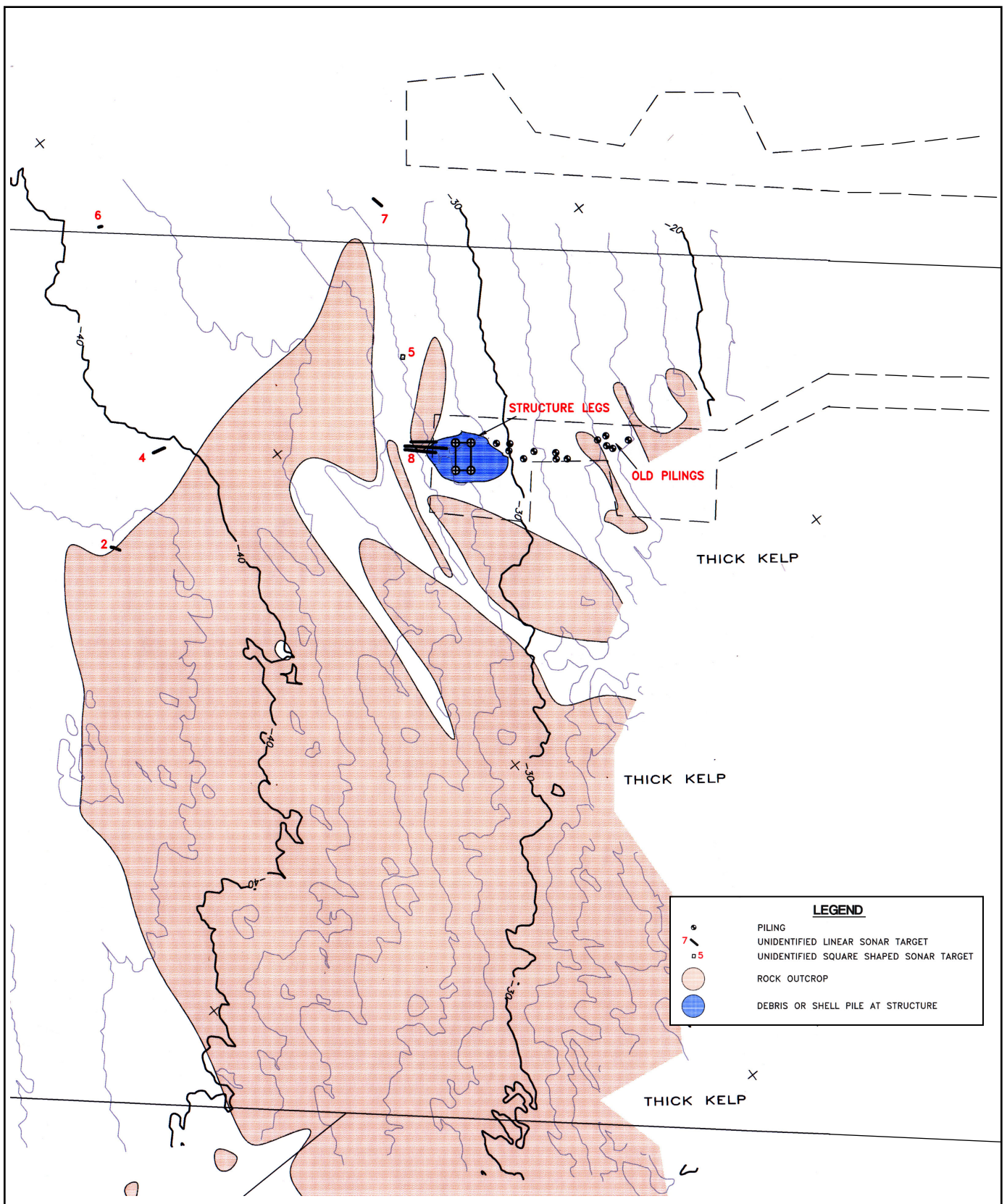
Historically, the Santa Barbara Channel has experienced a low to moderate level of seismic activity. Studies of the instrumental seismic record for the Santa Barbara Channel area show that earthquake epicenters can generally be correlated with east-west trending reverse faults and with concentrations of activity in the central and northeastern portions of the Channel. Recorded seismicity is relatively sparse in the western portion of the Channel. Only five earthquakes have exceeded magnitude 5.0 since 1900, the maximum magnitude of 6.2 occurred in 1925.

PRC 421 exists upon beach sand deposits at the base of a coastal terrace. The Moore Ranch fault is the closest fault to the site. The Moore Ranch fault is a west-east fault of the late Quaternary age and is located approximately one-half mile north of the site (Fugro 1996).

4.1.1.3 Currents and Sediment Movement

Nearshore sediment transport is more a function of the wave climate than of oceanographic currents. Currents on the north, i.e., mainland, side of the Santa Barbara Channel are primarily to the west, while sediment drift is to the east. The following discusses these features in more detail.

Circulation patterns in the Santa Barbara Channel are a subset of currents of the Southern California Bight (SCB). While the California Current, which flows toward the equator, dominates the flow off the western United States, its influence in the SCB is lessened because most of its flow is 110-270 miles (200 to 500 km) offshore. The Southern California Countercurrent is formed as an eddy that branches off the California Current near the southern U.S. border. It dominates the surface flow over the continental slope area of the SCB as a poleward-flowing counter current, especially during summer and winter (Hickey 1993). In spring the countercurrent is essentially absent, with the flow entering the SCB turning equatorward. In addition, there is a northward-flowing California Undercurrent toward the pole, typically between 330-980 ft (100 and 300 m) in depth. The near-surface currents over the mainland continental shelf in the SCB are predominately toward the equator (Hickey 1993; Santangelo et al. 1999). Alteration to the general circulation can result from the presence of land masses, changes in bathymetry, and local weather.



SOURCE: Fugro - 1999

Backside of 4.1-1

The general circulation pattern of the Santa Barbara Channel was described by Kolpack (1971) based on drift card data and by Pirie and Steller (1977) based on satellite imagery. Both describe a persistent cyclonic (clockwise) gyre that occupies the western and central parts of the Channel during all seasons. Mean currents are directed westward along the north shore of the Channel and eastward along the north side of the Channel Islands. Considerable work has been recently conducted to better characterize the subtidal near-surface circulation pattern of the Santa Barbara Channel. These studies have been included as part of larger the Santa Barbara - Santa Maria Basin Coastal Circulation Study (Harms 1996). Six synoptic views of this circulation have been described (Harms 1996; Harms and Winant 1998). Surface drifter experiments have shown consistency with these synoptic states (Dever, Hendershott, and Winant 1998). The patterns are described below and are shown in Figure 4.1-2.

- "Cyclonic" has a balanced counterclockwise flow around the boundaries of the basin. The currents along the northern boundary are westward, while those on the southern boundary are directed eastward. This flow pattern is strongest when water is drawn into the Channel through the eastern entrance of the SCB. Wind stress is strong and upwelling favorable with strong gradients. Surface pressure has a strong poleward along-shelf gradient with no cross-shelf gradient. This pattern is strongest in summer and weakest in winter.
- "Milling" ("Propagating Cyclones") is characterized by recirculating flow trajectories involving smaller cyclonic (counterclockwise) eddies that slowly drift to the west. This type of pattern cannot be described well by mean flow, so the uncertainty associated with this current pattern is very high. Wind stress is weak and upwelling favorable with weak gradients. Surface pressure has a weak poleward along-shelf gradient and no cross-shelf gradient.
- "Upwelling" has strong equatorward currents along the shelf at both ends of the channel and along the southern boundary, with a weak westward flow along the northern boundary. Wind stress is strong and upwelling favorable with strong gradients. Surface pressure has a weak northward along-shelf gradient and an onshore cross-shelf gradient.
- "Relaxation" has a strong narrow westward current (jet) from the eastern entrance along the northern boundary to Point Conception, while the southern boundary has a weaker eastward flow. Wind stress is weak and upwelling favorable with weak gradients. Surface pressure has a strong northward along-shelf gradient with an offshore cross-shelf gradient.
- "Flood East" has the flow directed eastward everywhere. Wind stress is strong and upwelling favorable with weak gradients. Surface pressure has an along-shelf gradient toward the equator and an onshore cross-shelf gradient. This pattern typically occurs in winter.
- "Flood West" has the flow directed westward everywhere. Wind stress is strong and downwelling favorable with weak gradients. Surface pressure has a northward

along-shelf gradient and an offshore cross-shelf gradient. This pattern typically occurs in winter.

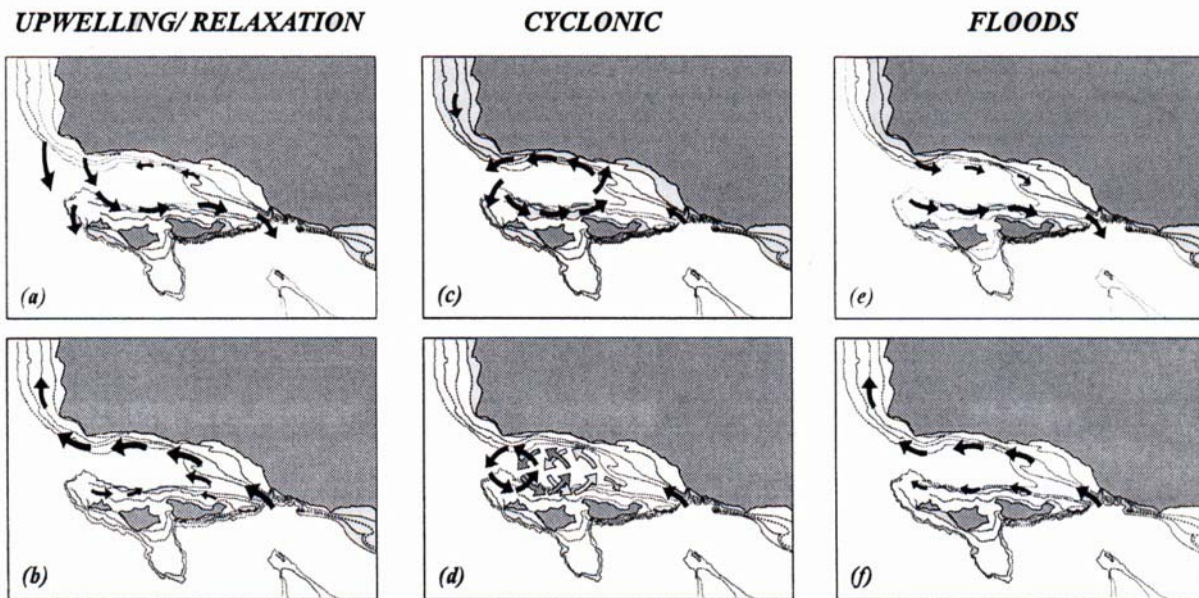


Figure 4.1-2. Schematic diagram of the six synoptic views of circulation in the Santa Barbara Channel. (a) Upwelling, (b) Relaxation, (c) Cyclonic, (d) Propagating Cyclones, (e) Flood East, and (f) Flood West (from Harms and Winant 1998).

The magnitude of the cross-shelf shear between along-shelf currents on opposite shelves fluctuates seasonally, being greatest during the summer and early fall, somewhat weaker in late fall and early winter, and weakest in later winter and spring. From March to mid-May, the Upwelling current pattern dominates the circulation with a variable strength cyclonic (counterclockwise) gyre superposed on the circulation. This cyclonic component can disappear for several days at a time. During summer and autumn, four of the current patterns commonly repeat in 4- to 16-day intervals to create a 16-day cycle. Randomly choosing a starting point, a typical cycle in the channel runs: Upwelling → Cyclonic → Relaxation → currents weak everywhere except for a northern side strong jet toward Point Conception.

There is seasonal variation in the prevalence of the synoptic states (Dever et al. 1998). Prevailing oceanographic and meteorologic conditions during the different seasons influence when these states are most apt to appear.

- Spring (March, April, May)—The Upwelling and Cyclonic patterns dominate.
- Summer (June, July, August)—The Upwelling, Cyclonic, and Relaxation states can all occur.

- Fall (September, October, November)—The Cyclonic and Relaxation states prevail. The Upwelling state seldom occurs.
- Winter (December, January, February)—Circulation has weak average velocities. The Relaxation pattern is evident.

Total wave climate consists of waves arising from several directions. Longer period swell (8-16 seconds with heights ranging from 1 to 16 ft [0.3 to 5.0 m]) is from the west-northwest in all seasons. Intermediate period swell (~3.5 seconds) is from the west or southwest. Shorter period (~2.0 seconds), generally southward, locally generated wind waves ("seas"), are superimposed on the swell (Emery 1958, cited in Hickey 1993). The long-period swell is generated primarily by North Pacific storms. Four primary meteorological sources generate swell-waves offshore of the project area: extratropical winter cyclones in the northern hemisphere, northwesterly winds during the spring transition and summer, tropical disturbances offshore Mexico, and extra-tropical storm swell generated in the southern hemisphere in the summer (Morro Group, Inc. 2000). The first two are the primary sources for the wave climate along the project area, although the last occasionally generate significant swell events from the south. The central Santa Barbara Channel, where the project site is located, is well protected by the Channel Islands from deep ocean waves approaching from all directions except westerly, i.e., down the axis of the Channel. In summer, the deep-water swells originate in the south Pacific; consequently, the Santa Barbara Channel is partially screened by the Channel Islands. Swells originating from storms near New Zealand can enter the western end of the Channel, but those from South American storms are almost entirely obstructed (NOAA 2000).

Waves are refracted by the shoaling seafloor to impinge on the coast more directly shoreward. Since the waves do not approach the shore exactly perpendicularly, but at a slight angle, the resulting net movement of sediment particles will be along the shore, in a direction forced by that angle. The interaction with the topography in the SCB, including the Santa Barbara Channel, generates a towards the equator (east, on the mainland shore of the Channel) longshore drift in the surf zone (Emery 1960, cited in Hickey 1993).

Wave energy behind physical structures is reduced and becomes less able to move particles of a certain size. Thus, sand and silt are deposited in the lee of breakwaters, groins, and even kelp beds (SCE 1990). Even a diffuse structure such as the remnant island and associated pilings can create an accumulation of sediment between it and the shore. Large storm wave events will resuspend and transport sediment.

4.1.1.4 Beaches

The shoreline adjacent to the project area is similar to much of the mainland shore of the Santa Barbara Channel, i.e., sandy (fine to medium-grained) beach backed by high bluffs. Because of the numerous natural oil seeps offshore, large deposits of tar are often found on the beaches of the area (USCG & OSPR 2000).

Data regarding the shoreline process for the Ellwood shoreline is limited (Noble Consultants, 2004). Longshore sediment transport at the project site is nearly unidirectional

from west to east. The estimated littoral transportation rate is approximately 275,000 cubic yards per year (210,253 cubic meters per year).

The principal components of the area's sediment budget include sediment delivery from the tributary creeks and streams of the Santa Ynez Mountain watershed (approximately three-quarters of the sand transported to the east by the longshore drift described above) and the smaller contributions of bluff erosion between Point Conception and the project site (Chambers Group 1992). The relatively limited sand supply within the shoreline reach and the characteristics of the local geology and bluff morphology explain why the beaches have eroded into the relatively narrow and sediment limited features that exist today. Over the past 70 years, the beaches have remained relatively stable. Temporal variation in berm width occurs regularly due to seasonal changes and short-term storm events. During winter, large, short-period waves generated by local storms will erode the beach, carrying sediment seaward. During summer, smaller, long-period waves carry sediment shoreward, regenerating the beach. Seasonal changes have been measured to be about 50 ft (15 m). Short-term storm erosion and recovery sequences can be greater.

4.1.1.5 Applicable Plans, Policies, and Regulations

Section 30230 of the California Coastal Act of 1976, as amended, states "Marine resources shall be maintained, enhanced, and, where feasible, restored." The Proposed Project would remove a delapidated structure from the marine environment and yet maintain offshore sea bird roosting/nesting capabilities with the installation of the new structures and enhance the extent of hard bottom substrate in the area.

The purpose of Santa Barbara County's land use plan (Local Coastal Program [LCP] in the *Santa Barbara County Coast Plan* [Santa Barbara 1995c]) is "to protect coastal resources, provide greater access and recreational opportunities for the public's enjoyment, while allowing for orderly and well-planned urban development and the siting of coastal-dependent and coastal-related industry." A review of the *Santa Barbara County Coast Plan* did not reveal any geology-related policies relevant to the removal of the PRC-421 pier remnant. A review of the more specific *Goleta Community Plan* (Santa Barbara 1995a) resulted in similar findings.

4.1.2 Impacts and Mitigation Measures

4.1.2.1 Methodology

The Proposed Project, the removal of the pier structures and debris, and installation of an artificial reef and bird roosting/nesting platforms and related quarry rock, may adversely impact nearshore and beach conditions. Increased levels of suspended sediments and turbidity may result from the Proposed Project activities. In addition, anchoring operations may impact exposed hardbottom conditions and associated biological communities. The short-term and long-term impacts of these activities will be evaluated based on the above information and a knowledge of oceanographic principles.

4.1.2.2 Significance Criteria

The Proposed Project would have a significant impact on geology, coastal currents, and nearshore sediment deposition and erosion if the Proposed Project would result in:

- potentially hazardous geologic conditions;
- substantial¹ disruption of the ocean floor;
- substantial alteration of coastal currents, wave action;
- substantial beach or bluff toe erosion;
- a substantial conflict with relevant regulations, e.g., maintenance of marine resources.

4.1.2.3 Geology and Sediment Transport Impacts

Short-term Impacts. The following are the potential short-term impacts of the Proposed Project .

GEO-1: Disturbance of sediment during removal of piles, toppling of caissons and placement of quarry rock.

Discussion:

There will be local disturbance of sediment during the removal process, toppling of caissons and placement of quarry rock. However, this disturbance will be temporary and negligible compared to sediment displacement during winter storms.

Impact/Mitigation:

As explained above, this is adverse, but not significant (Class 3). Therefore, no mitigation is required.

GEO-2: Impacts associated with subterranean geology.

Discussion:

The removal of the piles and toppling of caissons at the PRC-421 pier remnant will involve work at or slightly below the mudline. Placement of quarry rock will be on the ocean floor surface. Thus, these activities are too shallow to have any influence on the subterranean geology of the area.

¹ For the purpose of these significance criteria, substantial means that the magnitude of the effect would result in demonstrable damage to natural systems or to public health and safety..

The installation of the piles for the roosting/nesting platforms will occur in weathered to competent Monterey formation that exists beneath surficial sand sediments in the area. In the project area, there may be as little as zero sand sediment present to an estimated 4-ft (1.2 m) in depth (Fugro, 2001). Recent pile driving successfully occurred at the adjacent PRC-421 beachside piers where the Monterey formation was also encountered.

Based upon the subsurface profile at the site, governing codes and regulations, loading (dead load, live load, wave forces, wind and seismic conditions) and function of the proposed roosting/nesting platform structures, Bengal Engineering prepared an analysis of pile drivability and requirements for stable roost pile design (Bengal Engineering, November 2003). The analysis determined that piles should be driven to a minimum depth of 20 ft (6 m) into bedrock. The report further states that pile driving conditions are expected to be very hard at the project site and provided recommendations for pile driving that should be able to drive the 30-inch (76 cm) diameter piles. As the recommendations of the Bengal analysis are incorporated into the Proposed Project, no significant adverse impacts are anticipated from subsurface geology, or other factors, e.g., platform design, seismic conditions, etc, considered in the analysis.

Impact/Mitigation:

This impact is adverse, but not significant (Class 3). Therefore, no mitigation is required.

GEO-3: Anchor and chain abrasion of hard bottom.

Discussion:

The anchors and chain used to hold the barges in place during removal of these structures have the potential to disturb or damage rocky outcrops that provide habitat for benthic organisms (see more detailed anchoring impact and mitigation discussions in Section 4.4, Biological Resources [BIO-7 and BIO-8]).

To minimize the impacts of the Proposed Project on hardbottom areas the following have been incorporated into the Proposed Project, as described in the Applicant's Permit Application (December 2003):

- Mapping of hard bottom and kelp has been performed for the project area (see Figure 4.1-1, Figure 4.4-3, and Appendix C).
- Protection of hard bottom habitat is addressed through the *Anchor Mitigation and Hard Bottom Avoidance Plan* (Appendix C).
- Pre-designated anchor placements have been chosen to be located, where feasible, in soft-bottom habitat.
- Anchors will be "flown" via one of the support vessels before being dropped at its pre-determined location. Precise pre-determined anchor placements are located using DGPS positioning system. This shall reduce the dragging of anchors and their towlines across the ocean floor over hardbottom areas.

Impact/Mitigation:

Implementation of the protective measures outlined above will result in impacts that are adverse but not significant (Class 3). Therefore, no mitigation is required.

Long-term Impacts. The following are the potential long-term impacts of implementing the Proposed Project.

GEO-4: Seismic related impacts to proposed structure.

Discussion:

In 1972, the State of California passed the Alquist-Priolo Earthquake Fault Zoning Act (AP Act) to mitigate the hazard of surface faulting to structures for human occupancy. The act was renamed the Alquist-Priolo Special Studies Zones Act in 1975 and the Alquist-Priolo Earthquake Fault Zoning Act in 1994. The Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults.

The Act defines three categories of fault activity; active (demonstrated movement within the last 11,000 years), potentially active (movement within the past 11,000 to 2,000,000 years), and inactive (no movement within the past 2,000,000 years).

Since 1972, the California Geological Survey (CGS, formerly provided by the California Division of Mines and Geology) has issued a series of 1"=2,000' scale maps delineating Earthquake Fault Zones (EFZs). Structures proposed within mapped EFZs require geologic investigations to demonstrate that the structures will not be constructed across active faults. If an active fault is identified within the boundaries of the affected area, proposed structures must then be set back from the EFZ, generally a distance of 50 ft (15 m) on either side of the identified fault location. The CGS mapping program is ongoing, and areas not currently mapped as being within an EFZ could be included in an EFZ in the future.

Based on the review of published CGS Earthquake Fault Rupture maps (1997), the project site does not lie within an active EFZ. However, the Santa Barbara Channel is located within a seismically active region and the proposed structures will likely be subjected to seismic shaking during their life. In addition to seismic shaking, the structures may also be affected by tsunamis generated by either local or distant earthquakes. Settlement of the toppled caissons and quarry rock cover due to liquefaction of unconsolidated sand on the sea floor during a seismic event is not likely to occur due to the thinness of the deposits. The proposed new structures should not be affected by liquefaction as they will be sufficiently embedded, pursuant to the Bengal Engineering analysis, into the Monterey Formation.

Seismic design for the proposed structures will, at a minimum, follow seismic design recommendations as detailed in the Uniform Building Code (UBC, most recent version). Additionally, the design of the piles and the roosting/nesting platforms will conform to the applicable sections of the American Institute of Steel Construction (AISC) Steel Construction Manual and American Petroleum Institute (API) RP-2A-ASD "Recommended Practice for

Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design". Construction will be specified to be in accordance the American Welding Society (AWS) D1.1 Structural Welding Code.

Additionally, the engineering design investigated the ability of the installed piles to withstand a seismic event. A site-specific response spectrum curve was developed by Bengal Engineering for the Proposed Project. This information has been used to define construction parameters for the Proposed Project.

Impact/Mitigation:

This impact is considered to be adverse, but not significant (Class 3). Therefore, no mitigation is required.

GEO-5: Alteration of wave energy.

Discussion:

Noble Consultants conducted a numerical model analysis that is coupled nearshore wave-current-sediment system capable of simulating nearshore wave propagation, wave-induced, along-shore and cross-shore (seaward) currents, along-shore and cross-shore sediment transport as well as beach evolution for the proposed Project. In order to assess the long-term averaged impacts of the Proposed Project on coastal processes, two scenarios, without and with the Proposed Project, were modeled. A full discussion of the model and results are provided in the *Coastal Engineering Assessment PRC-421 Remnant Structure Removal* report prepared by Noble Consultants and included as Appendix T of this EIR.

Simulations were confined to a simplified representation of the without and with project condition to accommodate the constraints of the numerical model capabilities. The existing conditions scenario did not include the geometry of the existing PRC-421 remnant structures, and the with project condition model analysis did not include the proposed bird roosting platform support piles. Analysis was confined to a numerical simulation of the much larger and dominant submerged mound feature.

The effects of the existing remnant caissons and the small diameter piles proposed to support the bird roosting platforms on the local wave climate is considered to be insignificant. Their number and profile is relatively small in comparison to the larger diameter submerged mound. Furthermore, hydraulic model studies summarized in Wiegel (1964) indicate that a small number of widely spaced piles will not significantly alter wave conditions.

Based upon this information, it is estimated that the remnant caissons would only attenuate wave heights by about three percent or less within a very small area. Therefore comparison of an existing condition having no structures to the case of the proposed mound is considered to represent a conservative assessment. The small wave attenuation effects that will be associated with the existing remnant caissons indicate that the actual differences between pre and post project conditions will be slightly less than estimated.

The proposed bird roosting platform support piles will impact existing wave climate much less because of their smaller profile, spacing, and number. Therefore, it is estimated that their influence on coastal processes will be negligible.

The following discussion, as well as subsequent coastal processes impact discussions, are based primarily upon the Noble Consultants report.

Characteristics of the prevailing wave climate in the project area can be inferred from the Coastal Data Information Program (CDIP) Goleta buoy, which was deployed on June 25, 2002, in an area with water depth of approximately 600 ft (183 m) (Noble Consultants, 2004). One-year of wave data measured by this buoy between December 2002 and November 2003 was used as the representative offshore deep-water wave conditions for the Noble Consultants analysis of impacts of the Proposed Project on coastal processes.

The Goleta buoy data indicates that the measured significant wave height ranged from 1.3 to 11.8 ft (0.4 to 3.6 m), and the period varied from 4 to 23 seconds. Wave approach direction ranged from an azimuth of 100 to 280 degrees. The annual mean significant wave height is 3.5 ft (1.1 m), mean peak wave period is 9.1 seconds and wave approach angle is 259 degrees. For the one year period of record, approximately 98 percent of the deep-water waves propagated onshore with wave approach angles greater than 220 degrees azimuth.

The approximate shoreline orientation near PRC-421 is 127 degrees (landward shore normal angle is 217 degrees). The predominant wave approach direction from west to east is in agreement with the understanding that the along-shore current and sediment transport direction are almost always from upcoast to downcoast.

The introduction of a relatively small area of hardbottom substrate to the project area will result in relatively small changes to the incident sea and swell energy that will pass over and near the submerged mound. Refraction, diffraction, and shoaling effects due to the localized and more shallow depth of the quarry rock are estimated to result in some sheltering effects inshore of the structure and slight increases in wave height within relatively narrow zones immediately upcoast and downcoast of the hardbottom substrate mound location.

Because of the nearly unidirectional (westerly) approach of the sea and swell in the central Santa Barbara Channel, the limits of the wave shelter zone influenced by the submerged mound are estimated to be mostly confined within about 120 meters of surf zone area immediately inshore and downcoast of PRC-421. The narrow zones of elevated wave height that are predicted to occur on either side of the mound are estimated to result in slightly higher surf conditions in those areas. The predicted changes to the local wave climate are estimated to be within five percent of existing conditions. Therefore, the impact of the Proposed Project on the nearshore wave climate is deemed to be insignificant.

Impact/Mitigation:

Any long-term impacts on coastal currents due to the Proposed Project would be adverse but not significant (Class 3). Therefore, no mitigation is required.

GEO-6: Alteration of coastal currents.

Discussion:

The maximum depth of the remaining caissons of the PRC-421 pier and well support structure is 30 ft (10 m). The presence of the structure does not significantly affect the currents because of the small area occupied by the caissons and the open nature between them. The Proposed Project includes the removal of the pier remnants, construction of sea bird roosting/nesting platforms, retention of the toppled caissons, and addition of quarry rock to protect the piles and create hardbottom substrate. Because nearshore currents are directly related to incident wave conditions, changes to local inshore currents will exhibit a decrease and increase pattern mimicking the patterns discussed above for the wave climate. The proposed submerged hardbottom substrate will decrease the along-shore and cross-shore currents by no more than 16 percent within the wave shelter zone. Current velocities within the areas of elevated wave height are not expected to exceed 15 percent. As previously discussed, the influence of the proposed piles will be negligible. See also discussion of GEO-7, change to the nearshore sediment drift and beaches.

Impact/Mitigation:

The impact of the Proposed Project will be adverse, but not significant (Class 3). Therefore, no mitigation is required.

GEO-7: Change to nearshore sediment drift and beaches.

Discussion:

The PRC-421 pier remnants do not presently represent a significant influence on the nearshore drift of sediment in the region based on aerial photography (Figure 3-2) showing that the beach is not "growing" toward the structure, which would occur if there were a significant lessening of wave energy in the lee of the structure. The Proposed Project would result in the removal of the pier remnants; however, it also includes the retention of the toppled caissons and addition of quarry rock to create hardbottom substrate as well as the installation of piles on which four bird roosting/nesting platforms will be installed. The effect of the proposed structures on nearshore sediment drift and beaches was assessed by Noble Consultants and their findings are summarized below. As discussed previously, the impact of the piles will be negligible.

The along-shore sediment transport potential within the wave shelter zone created by the Proposed Project is estimated to decrease by less than 45,000 cubic yards per year (34,405 cubic meters per year) or about 16 percent of the existing transport rate. Noble Consultant's numerical model results indicate that littoral transport may increase as much as 33 percent within the narrow zones of increased wave energy. The net effect of these changes is anticipated to result in times of slightly increased beach width inshore of the proposed PRC-421 hardbottom substrate mound and occasions when more narrow beach width will occur for short distances immediately upcoast and downcoast of the site. The changes that may result are estimated to be less than the magnitude of the normal seasonal beach width changes that

presently occur along this shoreline. Seasonal berm width variation and short-term changes are at least 50 ft at Ellwood. More severe storms will temporarily denude the beach of all sand. These existing conditions are not expected to change after construction of the Proposed Project.

The cross-shore sediment transport potential is estimated to decrease by about 11 percent or less within the zone of wave shelter created by the Proposed Project. Increases of no more than approximately 30 percent are estimated to occur within the upcoast and downcoast zones where wave heights will be elevated. This corresponds to decreases and increases in cross-shore sediment transport within the respective areas.

Beach profile data surveyed at Ellwood since 1987 indicate that cross-shore sediment transport is mostly confined to areas inshore of the -30 foot (-10 m), MLLW depth. The predominance of rock outcrop and kelp in and around the PRC-421 pier structure remnant site suggests that onshore-offshore exchanges of sand also predominate within more shallow depths. Accordingly, it is estimated that the relatively deep water location of the offshore mound will not result in significant entrapment of sand.

Recession of the sandy beach may increase during storm events over the narrow upcoast and downcoast sections. However, the net effect is estimated to be insignificant when compared to the naturally occurring sediment limited conditions of the Ellwood shoreline. The potential along-shore and cross-shore rates of sediment transports for existing conditions already exceed available sediment supply. Thus, when more severe storm events occur, all sand from the beach is temporarily removed down to a resistant cobble and rock substrate level. It is during those times of depletion that the bluffs are vulnerable to and can experience episodes of toe erosion. The Proposed Project would not significantly alter or exacerbate this process.

Impact /Mitigation:

As explained above, the Proposed Project would not have a significant impact on sediment transport and beaches (Class 3). Therefore, no mitigation is required.

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